

THE RELATIONS OF LOGIC  
AND SEMANTICS TO ONTOLOGY

Philosophers have argued untiringly, over many centuries, about the ties of logic with ontology. While some have followed Parmenides in identifying the two, others – particularly since Abelard – have asserted the ontological neutrality of logic and, finally, a third party has oscillated between those two extremes.

Unfortunately it has seldom been clear exactly what is meant by the ‘ontological commitment’ of logic: mere reference to extralogical objects, the presupposition of definite ontological theses, or the ontological interpretation of logical formulas? Nor has an adequate tool for investigating this problem – namely a full-fledged semantical theory – been available. (Recall that the only existing semantical theory proper, i.e. model theory, is not competent to handle this problem because it is solely concerned with the relations between an abstract theory and its models, as well as with the relations among the latter.) Much the same holds for semantics, though with a remarkable difference. If semantics presupposes logic, and the latter is ontologically committed, so must be semantics. But of course semantics could be tied to ontology even if logic were ontologically neutral. Therefore we need an independent investigation of the ontological commitment, if any, of semantics.

The purpose of this paper is to investigate the relations of logic and mathematics to ontology and to do it with the help of a theory of meaning. This theory has been sketched elsewhere (Bunge 1972, 1973) and will be fully expanded in a forthcoming book. We assign meanings to constructs, in particular predicates and propositions, and distinguish two meaning components: sense and reference. The sense of a construct  $p$  in a context  $C$  is the totality of logical relatives of  $p$  in  $C$ . If  $p$  belongs to a theoretical context then the sense of  $p$  is the collection of statements within the theory that either entail  $p$  or are entailed by  $p$ . And the reference class of a construct  $p$  is the totality of individuals “mentioned” (truthfully or not) by  $p$ . Finally the meaning of  $p$  is the ordered pair constituted by the sense of  $p$  and the reference of  $p$ . We shall apply these ideas to find out the meaning

of the typical constructs of logic and semantics. But before doing so we must formulate those ideas somewhat more carefully. And before we tackle this task we must explain what we mean by a predicate and by a context.

### 1. PREDICATE AND CONTEXT

A predicate, or propositional function, is a statement-valued function, i.e. a function that maps objects of some kind into statements (propositions). For example, the predicate "Heavy" maps bodies into statements of the form " $b$  is heavy". And the propositional function associated to the  $\log$  function is a function mapping pairs of real numbers into statements of the form " $\log a = b$ ". (I.e., the predicate corresponding to the numerical function  $\log: R_+ \rightarrow R$  is  $L: R_+ \times R \rightarrow S$  such that  $Lxy = (\log x = y)$ , where  $x \in R_+$  and  $y \in R$ .)

We can express this in general terms provided we assume that the notion of a statement (proposition) has been elucidated before. We propose

**DEFINITION 1.** Let  $A_i$ , with  $1 \leq i \leq n$ , be sets of objects of any kinds, and let  $S$  be a set of statements. Then  $P$  is a *predicate* (or propositional function) with *domain*  $A_1 \times A_2 \times \dots \times A_n$  iff  $P: A_1 \times A_2 \times \dots \times A_n \rightarrow S$ , where  $S$  is the set of all those and only those statements involving  $P$ .

This non-Fregean definition of a predicate allows one to avoid Frege's confusion between *Bedeutung* (reference?, meaning?) and truth value, a confusion that invites the conflation of reference with extension and requires assuming some theory of truth before knowing what can be true or false.

Let us now turn to the notion of a context, which occurs in our definition of sense. It is introduced by

**DEFINITION 2.** The triple  $C = \langle S, \mathbb{P}, D \rangle$  is a *context* (or *framework*) iff  $D$  is a domain of individuals,  $\mathbb{P}$  a set of predicates whose domains are  $D^n$ , with  $n \geq 1$ , and  $S$  a set of statements in which only members of  $\mathbb{P}$  as well as logical predicates occur.

For example the loosely structured universe of discourse of a discipline is actually a context not just a set of individuals. Every one of the behavioral sciences has its own framework even though all of them concern the same individuals.

A slightly more structured context is one which is closed under the logical operations, so that it contains whatever could be said about a subject:

**DEFINITION 3.** The triple  $C = \langle S, \mathbb{P}, D \rangle$  is a *closed context* (or *framework*) iff it is a context and if  $S$  is closed under the logical operations.

Thus the collection of propositions in a given field of inquiry, plus their denials, pairwise disjunctions and conjunctions, as well as their generalizations and instantiations, belongs to a closed context.

Obviously a closed context is partially ordered by the relation  $\vdash$  of entailment. Moreover any two statements in such a context have both an infimum (their conjunction) and a supremum (their disjunction). Whence the

**LEMMA.** Every closed context is a complemented lattice.

Consequently we may define an ideal as well as its dual, i.e. a filter, on any closed context. And this will lead us straight on to our concept of sense.

## 2. THE SENSE OF A TAUTOLOGY

Consider a proposition  $p$  belonging to a closed context  $C = \langle S, \mathbb{P}, D \rangle$ . Since the latter is a lattice with respect to the entailment relation,  $p$  will induce its own ideal, called the *proper ideal* of  $p$ :  $(p)_C = \{x \in S \mid x \vdash p\}$ . Similarly the *proper filter* of  $p$  in  $C$  is  $)p(C) = \{y \in S \mid p \vdash y\}$ .

The same holds, mutatis mutandis, for every predicate in  $C$ : in this case the above are sets of predicates. In either case  $(p)_C$  is the collection of logical ancestors (or determiners) of  $p$ , whereas  $)p(C)$  is the logical offspring of  $p$ . And the union of the two constitutes the totality of logical relatives of  $p$ , which we regard as the full sense of  $p$ . Therefore we make

**DEFINITION 4.** Let  $C = \langle S, \mathbb{P}, D \rangle$  be a closed context and let  $p$  be either a predicate or a proposition belonging to  $C$ . Then

- (i) the *purport* (or upward sense) of  $p$  in  $C$  equals the proper ideal of  $p$  in  $C$ , i.e.  $(p)_C$ ;
- (ii) the *import* (downward sense) of  $p$  in  $C$  equals the proper filter of  $p$  in  $C$ , i.e.  $)p(C)$ ;
- (iii) the *full sense* of  $p$  in  $C$  equals the union of the purport and the

import of  $p$  in  $\mathbb{C}$ :

$$\mathcal{S}_c(p) = (p)_c \cap )p(c).$$

The full sense of a construct is then the totality of constructs of the same type (i.e. predicates or statements as the case may be) occurring in the context of interest and such that they entail the given construct or are entailed by it. Consequently in order to discover the sense of a proposition (or at least part of it) we must start by placing it in some closed context – preferably but not necessarily a theory; and must then proceed to finding out all the assumptions from which it hangs as well as all (or at least some) of its consequences. Likewise for predicates. Therefore only theories – rather than either experiments or philosophical vagaries – will tell us what the sense of theoretical concepts are. For example, to discover the sense of “electric charge” we resort to electrodynamics, not to experiment, let alone to the psychology of electric shocks.

Now, an arbitrary statement entails, among other propositions, all the tautologies found in the logic associated with the context in which it occurs. Likewise every predicate implies any tautological predicate. If we wish to retain only the synthetic or extralogical part of the sense of a construct, we must subtract logic from it:

**DEFINITION 5.** Let  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  be a closed context and  $L$  the logic associated with it. If  $p$  is a construct in  $\mathbb{C}$ , then the *extralogical sense* of  $p$  in  $\mathbb{C}$  is

$$\mathcal{S}_{\mathbb{C}}(p) = \mathcal{S}_c(p) - L,$$

i.e. whatever is in the full sense but not in the logic.

Clearly, whatever sense a construct has in addition to its logical sense, is determined by all the nontautological constructs it is related to within the context of interest, and in the first place by the primitive or basic constructs (which constitute the *gist* of the construct).

We are now equipped to face the problem of determining the sense of an analytic statement. Firstly we have

**THEOREM 1.** Let  $t$  be a tautology belonging to the logic  $L$  underlying a closed context  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$ . Then

(i) the purport (upward sense) of  $t$  equals the totality  $S$  of propositions

in  $\mathbb{C}$ :

$$\mathcal{P}ur_{\mathbb{C}}(t) = S;$$

(ii) the import (downward sense) of  $t$  equals the collection of all tautologies in  $L$ , i.e.  $L$  itself:

$$\mathcal{Imp}_{\mathbb{C}}(t) = L;$$

(iii) the full sense if  $t$  in  $\mathbb{C}$  is

$$\mathcal{S}_{\mathbb{C}}(t) = S \cup L;$$

(iv) the extralogical sense of  $t$  in  $\mathbb{C}$  equals the nonlogical part of  $S$ :

$$\mathcal{S}_{LC}(t) = S - L.$$

*Proof.* The first part follows from the fact that  $t$  is entailed by any proposition  $p$  in  $S$ ; i.e. every  $p \in S$  is in the purport of  $t$ . The second part follows from the interdeducibility of all the tautologies in a given  $L$ . The third follows with the assistance of Definition 4(iii) and the fourth with the help of Definition 5.

**COROLLARY 1.** Let  $\mathbb{C}$  be a purely logical context, i.e.  $S = L$ . Then the extralogical sense of a tautology  $t \in S$  is nil:

$$\mathcal{S}_{LC}(t) = \emptyset.$$

In other words, within logic tautologies do not “say” anything that is not strictly logical. It is only when meshing in with a body of substantive knowledge that logic does “say” something – in fact too much.

The dual of Theorem 1 concerns contradictions:

**THEOREM 2.** Let  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  be a closed context with underlying logic  $L$  and let  $t$  be a tautology of  $L$ . Then

(i) the purport of  $\neg t$  in  $\mathbb{C}$  is nil:

$$\mathcal{P}ur_{\mathbb{C}}(\neg t) = \emptyset;$$

(ii) the import of  $\neg t$  equals the totality  $S$  of proposition in  $\mathbb{C}$ :

$$\mathcal{Imp}_{\mathbb{C}}(\neg t) = S;$$

(iii) the full sense of  $\neg t$  in  $\mathbb{C}$  is:

$$\mathcal{S}_{\mathbb{C}}(\neg t) = S;$$

(iv) the extralogical sense of  $\neg t$  in  $\mathbb{C}$  is the set of nonlogical statements in  $\mathbb{C}$ :

$$\mathcal{S}_{\mathbb{C}}(\neg t) = S - L.$$

*Proof.* The first part follows from the tacit assumption that  $S$  is a consistent set of statements; if on the other hand  $S$  were to contain contradictions, these would be in the purport of  $\neg t$  because all contradictions are interdeducible. The second part follows from the fact that a contradiction entails anything. The third and fourth follow with the help of Definitions 4 (iii) and 5 respectively.

**COROLLARY 2.** Let  $\mathbb{C}$  be a purely logical context, i.e.  $S=L$ . Then the extralogical sense of a contradiction  $\neg t$ , where  $t \in L$ , is nil

$$\mathcal{S}_{\mathbb{C}}(\neg t) = \emptyset.$$

In sum, tautologies and their negatives have a definite sense which depends upon the context in which they occur. If the context is purely logical (e.g. a logical calculus) so is the sense of the tautology. A tautology “says” something provided it is embedded in a body of substantive knowledge, for then it hangs from every proposition included in that body. But what it “says” does not go beyond what that body of knowledge states. And isolated from every body of substantive knowledge, i.e. in itself, logic “says” nothing extralogical – as could not be otherwise.

In every context  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  we have then a minimal sense, namely  $L$ , and a maximal sense, viz.  $L \cup S$ . The sense of a construct that is neither tautologous nor contradictory lies between these extremes. More precisely, we have

**COROLLARY 3.** Let  $p$  be a construct in a closed context  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  with underlying logic  $L$ . Then the full sense of  $p$  is comprised between the intralogical sense and the full sense of a tautology in the same context, i.e.

$$L \subseteq \mathcal{S}_{\mathbb{C}}(p) \subseteq S \cup L.$$

For example, the sense of “probablity”, within pure mathematics, includes all the items in the calculus of probability that involve the probability function. But the sense, hence the concept itself, swells if placed in the context of applied probability theory. Another example: contrary to what

an extensionalist must suppose, “round square” is meaningful. If it were nonsensical, just because its extension is nil, we would be unable to assert the nonexistence of round squares. The statement “There are no plane figures both round and square” is provable in plane geometry, hence it has a nonempty purport in it; and it also has a nonvoid import: it “says” that points, triangles, etc., are not both round and square.

So much for the sense of tautologies and contradictions. We turn presently to the second component of meaning.

### 3. THE REFERENCE OF A TAUTOLOGY

The referents of “Terra lies between the sun and Jupiter” are the three bodies in question. In general, if a predicate  $P$  “applies” (truthfully or not) to objects  $a_1, a_2, \dots, a_n$ , then these are its referents. That is,

$$\mathcal{R}(Pa_1a_2 \dots a_n) = \{a_1, a_2, \dots, a_n\}.$$

Clearly, the denial of a statement does not change its reference class even though it alters its truth value. And if a second statement combines with the first either disjunctively or conjunctively, it contributes its own referents. That is, the reference function  $\mathcal{R}$  is insensitive to the propositional connectives:

$$\mathcal{R}(\neg p) = \mathcal{R}(p), \quad \mathcal{R}(p \vee q) = \mathcal{R}(p \& q) = \mathcal{R}(p) \cup \mathcal{R}(q)$$

for any propositions  $p$  and  $q$ . Similarly for predicates. Not surprisingly,  $\mathcal{R}$  is also insensitive to the precise kind of quantifier.

We sum up the preceding intuitive remarks in two definitions, one for the reference of predicates, the other for the reference of statements:

**DEFINITION 6.** The reference class of a predicate is the set of its arguments. More precisely, let  $\mathbb{P}$  be a family of  $n$ -ary predicates with domain  $A_1 \times A_2 \times \dots \times A_n$ . The function

$$\mathcal{R}_p: \mathbb{P} \rightarrow \mathcal{P}(\bigcup_{1 \leq i \leq n} A_i)$$

from predicates to the set of subsets of the union of the cartesian factors of the domains of the former, is called the *predicate reference function* iff it is defined for every  $P$  in  $\mathbb{P}$ , and its values are

$$\mathcal{R}_p(P) = \bigcup_{1 \leq i \leq n} A_i.$$

An almost immediate consequence of this definition is

**THEOREM 3.** The propositional connectives concern statements.

*Proof.* Apply Definition 6 to negation, then to disjunction, taking into account that the functional construals of these logical predicates are

$$\begin{aligned}\neg : S \rightarrow S, \quad \text{with} \quad \neg(s) = \neg s \quad \text{for any } s \in S; \\ \wedge : S \times S \rightarrow S, \quad \text{with} \quad \wedge(s, t) = s \wedge t \quad \text{for any } s, t \in S.\end{aligned}$$

A further consequence is

**COROLLARY 4.** The reference class of a tautological predicate equals the union of the reference classes of the component predicates. In particular

$$\begin{aligned}(i) \quad \mathcal{R}_p(P \vee \neg P) &= \mathcal{R}_p(P); \\ (ii) \quad \mathcal{R}_p((P)(P \vee \neg P)) &= \bigcup_{P \in \mathbb{P}} \mathcal{R}_p(P).\end{aligned}$$

As to the reference class of a statement, it will be computed with the help of

**DEFINITION 7.** Let  $\mathbb{P}$  be a family of  $n$ -ary predicates with domain  $A_1 \times A_2 \times \dots \times A_n$  and let  $S$  be the totality of statements formed with those predicates. The function

$$\mathcal{R}_s : S \rightarrow \mathcal{P}(\bigcup_{1 \leq i \leq n} A_i)$$

is called the *statement reference function* iff it is defined for every  $s$  in  $S$  and satisfies the following conditions:

(i) The referents of an atomic statement are the arguments of the predicate concerned. More precisely, for every atomic formula  $Pa_1a_2 \dots a_n$  in  $S$

$$\mathcal{R}_s(Pa_1a_2 \dots a_n) = \{a_1, a_2, \dots, a_n\}.$$

(ii) The reference class of an arbitrary propositional compound equals the union of the reference classes of its components. More precisely, if  $s_1, s_2, \dots, s_m$  are statements in  $S$  and if  $\omega$  is an  $m$ -ary propositional operation, then

$$\mathcal{R}_s(\omega(s_1, s_2, \dots, s_m)) = \bigcup_{1 \leq j \leq m} \mathcal{R}_s(s_j).$$

(iii) The reference class of a quantified formula equals the reference class of the predicate occurring in the formula. More explicitly, if  $P$  is an

$n$ -ary predicate in  $\mathbb{P}$ , and the  $Q_i$  (for  $1 \leq i \leq n$ ) are arbitrary quantifiers,

$$\mathcal{R}_s((Q_1 x_1) (Q_2 x_2) \dots (Q_n x_n) Px_1 x_2 \dots x_n) = \mathcal{R}_p(P).$$

The following consequence is immediate:

**COROLLARY 5.** The reference class of a tautological statement equals the union of the reference classes of the predicates involved. In particular

- (i)  $\mathcal{R}_s((x) (Px \vee \neg Px)) = \mathcal{R}_p(P)$
- (ii)  $\mathcal{R}_s((P) (x) (Px \vee \neg Px)) = \bigcup_{P \in \mathbb{P}} \mathcal{R}_p(P).$

For example, "The arrow moves or does not move" refers to a certain arrow. Its universal generalization "Everything either moves or it does not" refers to any object capable of moving, i.e. to all physical objects. And its higher order generalization "Whatever the property, everything either has it or it does not" refers to the whole set  $\Omega$  of objects, whether physical or mental. We call such tautologies *universal*. The second part of Corollary 5 can then be rewritten as

**COROLLARY 6.** Any universal analytic statement  $t \in L$  in a logical theory  $L$  refers to all objects:

$$\text{If } t \in L \text{ then } \mathcal{R}(t) = \Omega.$$

Because of Definition 7(ii), the same holds for contradictions. On the other hand the extension of a contradiction is nil. This is a warning against the temptation to identify reference with extension.

So much for the second component of meaning. We are now in a position to find out the meaning of a logical formula.

#### 4. THE MEANING OF A TAUTOLOGY

As we have seen, the sense function  $\mathcal{S}$  maps constructs into sets of constructs, i.e.  $\mathcal{S}: C \rightarrow \mathcal{P}(C)$ , whereas the reference function  $\mathcal{R}$  maps constructs into sets of objects of any kind, i.e.  $\mathcal{R}: C \rightarrow \mathcal{P}(\Omega)$ , where  $\mathcal{P}$  is the power set function. Since the maps  $\mathcal{S}$  and  $\mathcal{R}$  have been defined, the function

$$\mathcal{M}: C \rightarrow \mathcal{P}(C) \times \mathcal{P}(\Omega)$$

remains uniquely determined for each type of construct. We call it the *meaning function*. In other words, we adopt

**DEFINITION 8.** Let  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  be a closed context and  $p$  a predicate or a proposition in  $\mathbb{C}$ . Then the *meaning of  $p$  in  $\mathbb{C}$*  is the sense of  $p$  together with the reference of  $p$ :

$$\mathcal{M}_{\mathbb{C}}(p) = \langle \mathcal{S}_{\mathbb{C}}(p), \mathcal{R}_{\mathbb{C}}(p) \rangle$$

Putting together Theorem 1 and Corollary 6 we get

**COROLLARY 7.** The meaning of a universal tautology  $t \in L$  in an arbitrary context  $\mathbb{C} = \langle S, \mathbb{P}, D \rangle$  is  $S$  plus logic together with the set  $D$  of all objects in  $\mathbb{C}$ :

$$\mathcal{M}_{\mathbb{C}}(t) = \langle S \cup L, D \rangle.$$

By Corollary 1, analytic statement, when detached from all bodies of substantive knowledge, are devoid of extralogical sense, ergo

**COROLLARY 8.** Universal tautologies say nothing about everything:

$$\mathcal{M}_{LC}(t) = \langle \emptyset, D \rangle.$$

The dual of Corollary 7 is

**COROLLARY 9.** Universal contradictions say anything about everything:  
If  $t \in L$  and  $\neg t \in \mathbb{C}$ , then  $\mathcal{M}_{\mathbb{C}}(\neg t) = \langle S, D \rangle$ .

In all three corollaries, the domain  $D$  blows up to the entire set  $\Omega$  for maximally general analytic statements.

Analytic propositions, in short, are meaningful: they have the smallest possible sense and the largest possible reference.

From the fact that universal tautologies “apply” to (are true of) anything, or “hold in every possible world”, it has been concluded that logic is a kind of ontology (see e.g. Scholz, 1941; Hasenjaeger, 1966). This is an unwarranted conclusion for, although a universal tautology *refers* to anything, it *describes* nothing but logical objects such as “or” and “entails”. This is what Corollaries 7 and 8 state. And it is perhaps what is meant when claiming the opposite view, namely that tautologies are meaningless. Tautologies, if our semantics is adequate, have a sense

but by themselves they state nothing about the word even if they refer to it.

The foregoing analysis does not disprove the thesis that logic can be assigned ontological *interpretations*. No doubt, it is admissible to interpret the individual variables as ranging over entities and the extralogical predicates as ranging over properties of entities. Upon proceeding in this fashion one obtains, for instance, the following interpretation of the excluded middle principle: "Every entity either has a given property or fails to have it". Yet this ontological interpretation does not yield an ontological *thesis*, e.g. a metaphysical axiom, but rather a retreat from every ontological commitment. Ontology is supposed to make definite and positive statements about the structure of the world instead of evading the issue as logic does. In short, the ontological interpretations of logic are harmless: far from constituting a sort of minimal ontology they are a reminder that logic is context-free, i.e. invariant under changes in contexts or fields of inquiry. Moreover, if analytic statements did say anything definite about reality they would be at the same time synthetic. Finally, even if an ontological interpretation of logic were to pass for ontology, it still would be something other than pure logic.

Finally, none of the preceding arguments disposes of an even more radical thesis, namely that logic *presupposes* an ontology. But this claim can be disposed of in three sentences. Firstly, the only place where an ontology might creep into logic is by way of the notion of domain of a predicate (Section 1), which set must not be empty for the predicate to exist. However, and secondly, the individuals forming that set need not be specified: they could be physical, conceptual, or even totally nondescript, as they are in the case of, say, an unspecified unary predicate  $P : A \rightarrow S$ . Finally, the mere requirement that such domains, e.g.  $A$ , be nonempty, is not an ontological assumption but a condition for  $P$  to be *called* a predicate: indeed  $P$  won't be such unless it attributes or assigns a property to something. In sum, logic presupposes no ontological thesis. It is rather the other way around: any cogent ontology presupposes some logic.

Logic, in sum, is ontologically noncommittal. This is why it can be made to reign over all contexts. What about semantics? This is another story.

## 5. SEMANTICS AND ONTOLOGY

If we now apply our theory of reference to some of the typical concepts

of semantics, it turns out that while some of them refer to constructs others refer to objects of any kind. For example, the reference relation maps constructs into sets of objects (subsets of  $\Omega$ ), whence the corresponding predicate is the propositional function

$$\text{REF}: C \times \mathcal{P}(\Omega) \rightarrow S \text{ such that } \text{REF}(c, A) = \lceil \mathcal{R}(c) = A \rceil$$

for  $c$  in  $C$  and  $A$  in  $\mathcal{P}(\Omega)$ . Hence  $\mathcal{R}(\mathcal{R}) = c \cup \mathcal{P}(\Omega) = \mathcal{P}(\Omega)$ . Likewise for the extension function.

We might conclude that semantics as a whole does refer to objects of any kind. But it does so in the same noncommittal way that logic “applies” to anything, that is, without describing or representing (let alone explaining and predicting) the behavior of anything but its specific concepts. Hence, as far as reference is concerned, semantics is just as noncommittal as logic.

It would seem then that Tarski (1944 p. 363) was right in asserting that ontology, in case it exists, “has hardly any connections with semantics”. This is obviously true of the semantics Tarski had in mind, namely the semantics of mathematics, or model theory. Indeed, mathematics is the study of conceptual structures, such as lattices, number systems, manifolds, and categories, and model theory focuses on the most abstract of all structures. None of these is an entity or real thing, i.e. the object of ontology. But Tarski’s dictum does not apply to the semantics of factual (empirical) science – which anyway did not exist at the time Tarski made that statement. In fact this other semantical theory meets metaphysics at least at two points: reference and truth. Let us glance at these interfaces.

Clearly, a general theory of reference needs no ontological background. But the *applications* of any such theory to the semantic analysis of factual predicates and propositions do call for certain definite assumptions as to what counts as a referent. Consider the statement  $\lceil \text{Car } b \text{ stopped at point } p \text{ at time } t \rceil$ . Do  $b$ ,  $p$  and  $t$  qualify as referents? They do according to the naive ontology of the man in the street, to whom space and time are as real as cars. But alternative ontologies will come up with different identifications of the referents. In a process metaphysics there will be a single referent, namely the event of the car stopping. And in a systems metaphysics there will be two referents, namely the car and the thing located at  $p$  and  $t$ .

Ontology raises its head also in the matter of truth. Certainly the coherence theories of truth need no ontological assumption. (Incidentally the model theoretic concept of truth as satisfaction in a model belongs in this class, since it construes truth as the fitting of one conceptual structure to another.) But the concept of (factual and partial) truth used in daily life and in the sciences is the one that ought to be elucidated by a (nonexistent) correspondence theory of truth. And obviously, if an *ens rationis* is to be adequate to a *res* (thing or fact), then we must begin by assuming that *there are* such *rei* or extraconceptual objects. In other words, the view that truth consists in an *adaequatio intellectus ad rem* requires the existence of *rei*. This is surely a modest ontological assumption, yet one that non-realists, such as subjective idealists and logical positivists, do not accept. Nor do they need it: the former because the coherence theory suffices them, the latter because they have no use for any theory of truth except perhaps the trivial theory of truth by convention.

Note finally that our last argument is independent from Quine's thesis that the mere use of the existential quantifier commits us to ontology (cf. Quine, 1969). Firstly, we were discussing semantics not logic. Secondly, we were concerned with factual truth not with quantification theory. Thirdly, in our view  $\Gamma(\exists x)Px\sqcap$  asserts the existence of *P*'s – but these objects may or may not be physical, depending on the interpretation of *P*. As it stands, the proposition is a neutral existence assertion and moreover one that could be made just for the sake of the argument. And it is just as well that a mere unqualified existential quantifier carries no ontological load if logic is to be valid regardless of the interpretation of the extralogical predicates. We do commit ourselves one way or another just if we transform the preceding existence statement into either  $\Gamma(\exists x)(Px \ \& \ x \text{ is a physical object})$  or  $\Gamma(\exists x)(Px \ \& \ x \text{ is a mental object})\sqcap$ . Thus the physical scientist who undertakes to investigate any sector of physical reality presupposes unwittingly that there are physical objects. So does the ontologist.

## 6. CONCLUSIONS

We have employed our semantical theory to investigate the matter of the ontological commitment of logic and semantics, and have found the following results:

- (i) The logical predicates, such as "or" and "entails", are about state-

ments not about any other objects. Moreover this is what a logical theory is supposed to characterize, namely logical objects, and only such.

(ii) Tautologies refer, now to conceptual objects, now to physical ones, now to all objects. But they describe or characterize none. Hence logic is not "*une Physique de l'objet quelconque*" (Gonseth, 1938, p. 20). Logic is no more and no less than the theory of logical form, in particular of the form of deductive arguments.

(iii) The general theory of reference we propose does not specify the nature of the referents of a construct, hence it is not ontologically committed. By contrast, any application of the theory is ontologically committed. This commitment is made the moment the predicate under scrutiny is analyzed as a function mapping  $n$ -tuples of objects into statements. Such an analysis requires the identification of such objects, which identification is based on some hypothesis or other concerning the furniture of the world. But the identification itself is a task for the special sciences not for semantics.

(iv) The correspondence theory of truth is committed to the thesis that there is an external world, i.e. that there are entities that a factually true statement fits. Hence the chapter of semantics dealing with the notion of *vérité de fait* is not ontologically neutral. And it does not overlap with model theory.

In a nutshell: whereas logic is ontologically neutral, semantics is partially committed to some ontology or other. Of course this result is critically dependent upon our semantical theory. Hence anyone wishing to dispute it should avail himself of an alternative semantical tool.

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